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The 1991 "Neural Information Processing Systems-Natural and Synthetic" (NIPS) was held in Denver Colorado, from 2-5 December 1991. Since its inception in 1987, th NIPS conference has attracted researchers from many disciplines who are applying their expertise to problems in the field of neural networks. The conference and the following two day workshop have become a forum for presenting the latest research results and for leading researchers to gather and exchange ideas. The 1991 conference maintained the high level of excitement of its predecessors. Important new theoretical results were presented concerning the capability and generalization performance of networks.

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Department of Computer Science and Engineering

OREGON GRADUATE INSTITUTE
OF
SCIENCE & TECHNOLOGY

[illegible] N.W. 150th Avenue Drive
Beaverton, Oregon 97006-1999 U.S.A.
Phone 503 [illegible] FAX 503 [illegible]

February 4, 1993

Capt. Steven Suddarth, Ph.D.
AFOSR/NE, Bldg. 410
Bolling Air Force Base
Washington, DC 20332

Dear Dr. Suddarth:

YALE U ← This letter and the attached materials constitute the final report for AFOSR Grant 91-0138 which provided $5,000 for student travel grants for the 1991 Neural Information Processing Systems Conference. The money was used to help 20 students as indicated in the attached list.

Also attached is a copy of the front matter of the proceedings which resulted from NIPS '91. As is evident, many of the students we were able to help made substantial contributions to the conference program. We are very grateful for your generous support and hope that you will be able to continue to support NIPS conferences in the future.

Sincerely,

John Moody

John Moody
Associate Professor
NIPS*91 General Chairman

YALE UNIVERSITY
Department of Computer Science and Engineering

OREGON GRADUATE INSTITUTE
of
SCIENCE & TECHNOLOGY

19600 N.W. von Neumann Drive
Beaverton, Oregon 97006-1999 U.S.A.
Phone: 503 690-1151 FAX: 503 690-1686

1.*	$250	Quanfeng Wu	qw0w@andrew.cmu.edu
2.*	$250	David Plaut	dcp@cs.cmu.edu
3.*	$250	John Hampshire	hamps@speech2.cs.cmu.edu
4.*	$250	Frederick Waugh	waugh@curly.harvard.edu
6.*	$250.	Lori Pratt	pratt@paul.rutgers.edu
7.*	$250.	Barak Pearlmutter	barak@james.psych.yale
8.*	$250.	Alexandre Pouget	alex@cajal.edec.edu
9.*	$250	Steve Fisher	fisher@helmholtz.sdsc.edu
10.*	$250.	Sowmya Ramachandran	sowmya@cs.utexas.edu
11.*	$250	Andrew Moore	awm@mit.ai.edu
12.*	$250.	Zoubin Ghahramani	zoubin@psyche.mit.edu
13.*	$250.	Ying Zhao	yzhao@ai.mit.edu
14.*	$250	David Cohn	pablo@cs.washington.edu
15.*	$250	Steve Nowlan	nowlan@helmholtz.sdsc.edu
16.*	$250	Sherif Botros	smb@ai.mit.edu
17.*	$250	Gary Scott	scott@chewi.che.wisc.edu
18.*	$250	Tony Bell	tony@helmholtz.sdsc.edu
20.*	$250.	Elizabeth Thomas	cmjv465@hermes.chpc.utexas.edu
22.*	$250	Tony Zador	zador@cs.yale.edu
23.*	$250	Antonette Logar	N0801@ttacs1.ttu.edu

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EDITED BY

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YALE UNIVERSITY

STEVE J. HANSON
SIEMENS RESEARCH CENTER

RICHARD P. LIPPMANN
MIT LINCOLN LABORATORY

MORGAN KAUFMANN PUBLISHERS
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PREFACE

This volume contains 144 papers summarizing the talks and posters presented at the fifth NIPS conference (short for "Neural Information Processing Systems—Natural and Synthetic"), held in Denver, Colorado, from 2–5 December 1991. Since its inception in 1987, the NIPS conference has attracted researchers from many disciplines who are applying their expertise to problems in the field of neural networks. The conference and the following two-day workshop have become a forum for presenting the latest research results and for leading researchers to gather and exchange ideas.

The 1991 conference maintained the high level of excitement of its predecessors. Important new theoretical results were presented concerning the capability and generalization performance of networks. Of particular interest are papers included in this volume by Vapnik, MacKay, Haussler, and others, which describe how to relate the complexity of networks to generalization performance on unseen test data. Many new network architectures were described. Some integrate expert system rules with networks, build hierarchies of networks, use radial basis function hidden nodes, and impose pre-specified invariance on the final solution. Neurobiological papers analyzed and modeled neurons in the hippocampus, in cat striate cortex, and in the blowfly. They also modeled biological networks that control eye movement, form topological maps, and compensate for head movement. Successful applications of neural networks were described in the areas of speech, vision, language, control, medical monitoring, and system diagnostics. Of particular interest was a paper by Tesauro, which demonstrated how a network could be trained to play backgammon at an expert level; papers by Jain, Watrous, and Giles, which described approaches to learning grammars; hybrid hidden-Markov-model/neural-network speech recognizers described by Haffner, Levin, Singer, Renals, and Bengio; papers on optical character recognition; a paper by Jabri, which describes a network to control a wearable heart defibrillator; a paper by Smyth for diagnosis of large-dish antenna pointing systems; and a paper by Röscheisen concerning control of force on rollers in steel rolling mills. Papers also described new analog and digital VLSI chips, systems for neural network implementation, and compared neural network and statistical approaches to pattern classification.

An historical milestone was reached this year, NIPS-91 was the fifth NIPS conference since the first conference was held in 1987. To mark this anniversary, we decided to review the history of events that led to the foundation of the NIPS conference and to discuss the evolution of the conference since its foundation. The following history is based in part on the recollections of Jim Bower, Larry Jackel, and Ed Posner. Some of this history was presented by Larry Jackel at the opening banquet.

While the first NIPS conference met in 1987, its origins can be traced back to the "Hopfest" meetings named in honor of John Hopsfield, held at Caltech. The first few, 1984–1986, were organized by Ed Posner of Caltech. These meetings met in the fall and included researches mainly from the Caltech campus and JPL. In 1985, Larry Jackel of Bell Labs and Demetri Psaltis of Caltech organized the first of what were to become the "Snowbird" meetings. The meetings were intended to be small informal workshops and convened in Santa Barbara. Twenty people were invited, but news of the meeting spread by word of mouth, so that attendance ended up growing to 60. In 1986, the meeting reconvened at Snowbird, which offered better snow conditions. Jackel, Psaltis, and the other organizers intended to keep the attendance down to 100 people, but the interest was so great that many people were turned away even after the attendance was capped at 160. The first Snowbird proceedings was edited by John Denker of Bell Labs and published by the American Institute of Physics (AIP) press.

In 1986, the Snowbird meeting was the only neural network conference, and it clearly could not accommodate the exploding numbers of researchers becoming interested in the field and still maintain the character of a small workshop. To respond to demand, the organizers decided to make Snowbird a more closed meeting, but to set in motion organization of a large meeting that would be open to all interested. The goal was to have a non-commercial meeting, dedicated to scholarship, which would capture some of the flavor of the workshop. The Snowbird organizers nominated a committee with Ed Posner as General Chairman and Yaser Abu Mostafa as Program Chairman (both of Caltech), to organize and run the 1987 NIPS conference, which was officially sponsored by the IEEE Information Theory Society. Denver was chosen as the site due to its central geographical location, ease of access by air, and close proximity to the mountains and the University of Colorado at Boulder.

The 1987 organizers designed the NIPS conference to have many of the advantages of a workshop, while still accommodating a large audience. To maximize scientific interchange, they decided to limit the oral presentations to a single stream, have posters be the majority of presentations, and include poster preview as well as formal poster sessions. Furthermore, a set of post-conference workshops was organized at the Copper Mountain ski resort after the main conference to enable small groups to discuss specific topics. The 1987 conference proved to be a great success, with about 450 attendees and 91 papers making it into the proceedings. Dana Z. Anderson of CU Boulder edited the proceedings, which were published by the AIP press and are now informally known as NIPS Volume 0.

Since 1987, some changes and refinements have been made, but the basic structure of the conference has remained the same. The NIPS 1988 proceedings (NIPS Volume 1, edited by David Touretzky of Carnegie Mellon) were the first published by Morgan Kaufmann. Also in 1988, the post-conference workshops were moved to Keystone, CO. The refinement processes (three reviewers instead of two), a more cross-disciplinary grouping of presenta-

tions, finer presentation catagories, and the addition of five-minute oral poster spotlight presentations. A major and very successful addition to the 1991 conference was the introduction of a day of tutorials preceding the main conference. The 1991 workshops were held at Vail, which proved to ba a popular move.

Finally, 1991 marked the drafting of articles of incorporation for the Neural Information Processing Systems Foundation, which will be responsible for the continuity of the NIPS conference in future years. The initial board of directors of the foundation consists of the 1987 to 1992 NIPS General Chairs (Ed Posner of Cal Tech, Terry Sejnowski of the Salk Institute and UCSD, Scott Kirkpatrick of IBM, Richard Lippmann of MIT Lincoln Labs, John Moody of Yale, and Stephen Hanson of Siemens), a member of the IEEE Information Theory Society (Terry Fine of Cornell), and our legal counsel (Philip Sotel).

The NIPS conference continues to be an exciting, successful meeting due to the efforts of a large group of people. We would first like to thank all the other members of the 1991 program and organizing committees who helped make this conference possible, In particular, we would like to thank Renate Crowley of Siemens for her extensive work throughout the year as the conference secretary and both Renate and Kate Fuqua of CU Boulder for running the conference desk so smoothly. Student contributions are an important part of the NIPS program, and we gratefully thank Tom McKenna of ONR and Steve Suddarth of AFOSR for the student travel funding provided by their agencies. Finally, we thank everyone who attended and submitted papers and the 105 referees who carefully read and reviewed 20 papers each.

John Moody

Stephen Hanson

Richard Lippmann

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